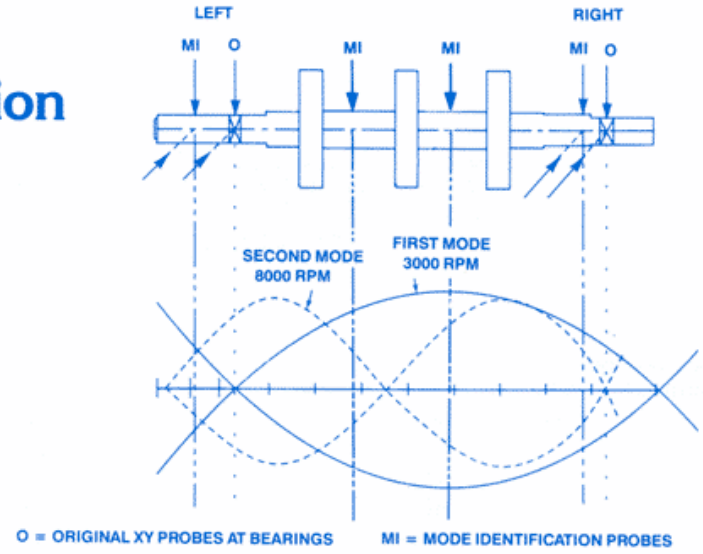
ProbeTip

Mode Identification Probes



Bently Nevada pioneered XY shaft relative probes and Keyphasor® transducers which are widely used today for machinery monitoring. These transducers provide the fundamental data needed for proper rotating machinery monitoring and analysis. However, an additional measurement method can be used to more completely characterize a machine's dynamic behavior. Machinery monitoring and problem diagnosis can be significantly improved by the addition of Mode Identification (MI) Probes which help to accurately identify synchronous mode shapes. To accomplish this, additional proximity probes are located inboard and/or outboard of normal bearing monitoring points and adjacent to couplings.

Lateral mode shape information is extremely valuable for balancing rotating machinery and identifying faults such as shaft cracks, bearing failures, rotor to stator rubs, etc. Without lateral mode shape information and the location of rotor nodal points (zero motion), proximity probes may inadvertently be located at nodal points. At these nodal points, the probes observe little or no shaft motion and therefore cannot provide meaningful information. To further complicate matters, shaft nodal points can (and do) shift along the shaft rotative axis as a function of rotor speed. In addition, nodal points may shift due to changes in bearing/seal clearances, machine alignment, rotor unbalance, shaft crack propagation, casing/rotor thermal expansion and rotor-to-stator rubs.

The figure shows a typical rotor configuration and its lateral mode shapes. In this example, the original XY probes (O) are mounted in the middle of the radial bearings. The left nodal point for the first mode is very near the left bearing centerline and its set of XY probes. For the speed range associated with the first mode, this location is essentially left unsupervised. The right nodal point for the second mode is very near the right bearing centerline and its set of XY probes. This leaves the right end of the machine unsupervised for malfunctions associated with the second mode.

It is recommended that ***at least one additional MI Probe be installed at each end of a machine or at each radial bearing.*** The probe should be installed at the same angular location as one of the XY probes installed at the nearest bearing. As a general rule, its axial location should be a ***minimum*** of two shaft diameters away from the nearest set of XY probes.

Expanding the minimum single MI Probe to an XY pair and installing additional MI Probe sets along the shaft will provide even more valuable information for diagnostic and baseline purposes. In addition, radial displacements measured along the shaft axis by a series of XY and MI Probe sets can be used to more accurately identify shaft deflections and slope. The information can then be used to evaluate shaft stiffness and bending stresses. Changes in system dynamic stiffness provide an early warning sign of shaft cracks, bearing wear and other related malfunctions. Knowing the locations of highest bending stresses and how the stresses change under different operating conditions provides valuable information. You can then pinpoint those areas for maintenance inspections to aid in extending the machine's operational life. Additionally, detailed information on shaft motion, deflections and seal clearances can help determine which seals are most susceptible to rubs.

By using XY and MI Probes, valuable diagnostic information for basic monitoring and additional dynamic stiffness, deflection and stress information can be available. ■